

UPPER-AIR OBSERVATIONS AT APIA OBSERVATORY

By ANDREW THOMSON

[Apia Observatory, Apia, Western Samoa]

This preliminary report summarizes the results of 141 pilot-balloon flights taken at Apia Observatory between June 1, 1923, and December 31, 1924. The complete data giving the details for individuals flights will be published shortly in an observatory bulletin.

The Apia Observatory, $13^{\circ} 48.4' S$, $171^{\circ} 46' 30'' W$, on the island of Upolu of the Samoan group, is situated in the western portion of the South Pacific Ocean. It lies very remote from large land masses, the coast of South America is 10,000 kilometers to the east and the continent of Australia 4,000 kilometers to the west. Although there are numerous islands in this expanse, their area is so small that the effects exerted on the great circulation of the atmosphere must be inconsiderable.

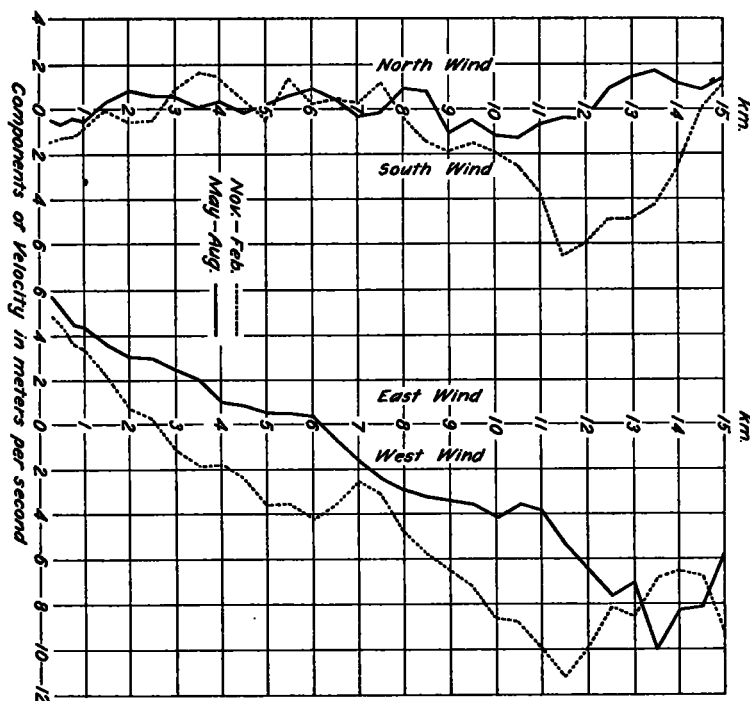


FIG. 1.—Components of winds in the upper air at Apia, Western Samoa ($13^{\circ} 48.4' S$, $171^{\circ} 46.5' W$).

On the open ocean in the vicinity of Samoa trade winds from the quadrant southeast to northeast blow for 48 per cent of the time during the quarter December to February and for 85 per cent of the time from June to August.¹⁰ The observatory is shielded from south winds by a range of hills which reach a height of 1,100 meters, the effect of which in diverting the circulation to a more east-west direction has been found by kite observations to extend to an altitude of 500 meters.¹¹

Rubber balloons weighing 25-35 grams and 60-70 grams were inflated to rise at a rate of 180 meters per minute. The single theodolite method was employed and the procedure and methods of the United States Weather Bureau were adopted throughout. Balloons were sent up on almost every occasion when the sky gave promise of remaining free from clouds for 30 minutes or more; about 80 per cent of the ascents were made between 10 a. m. and 3 p. m. One balloon was observed to a

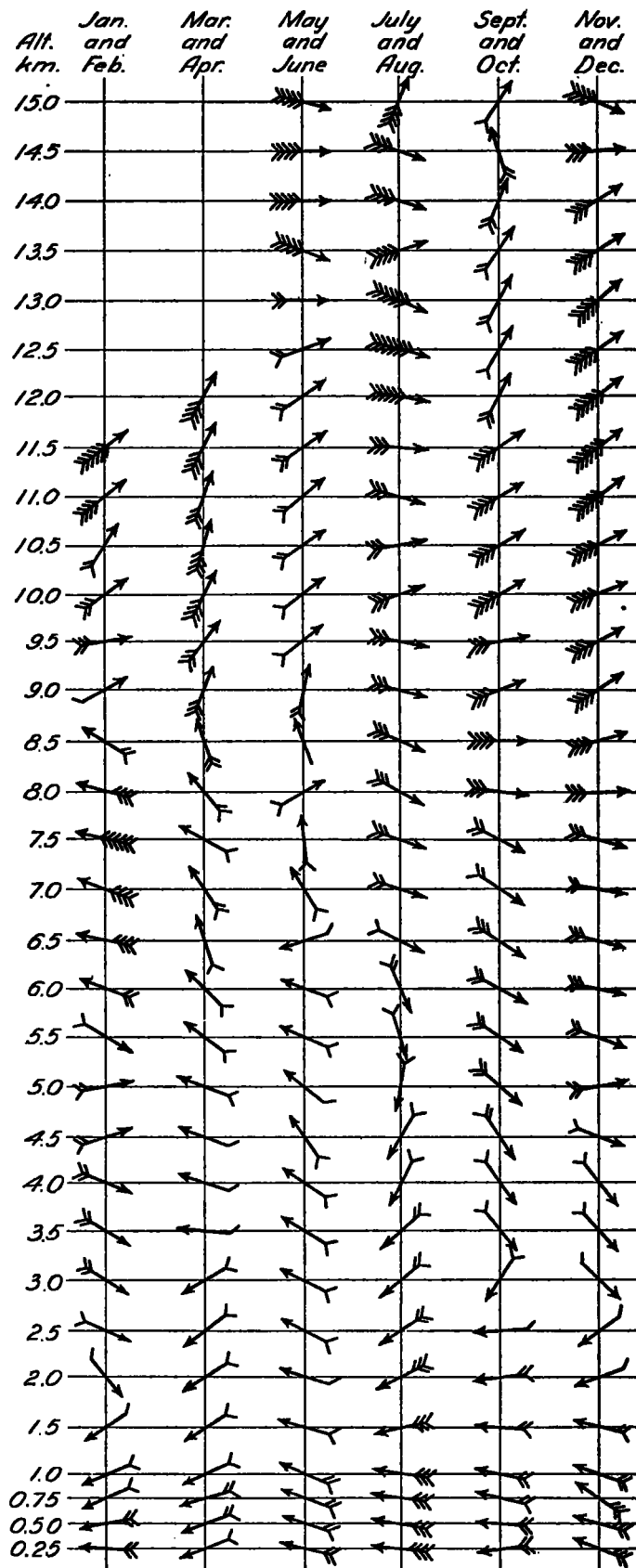


FIG. 2.—Mean wind directions and velocities at Apia, Western Samoa. Arrows fly with the wind: Velocities in meters per second, each feather representing one meter per second.

¹⁰ South Pacific Pilot Charts, U. S. Hydrographic office.

¹¹ G. Angenheister, a summary of the meteorological observations of the Apia Observatory, p. 51.

height of 21 kilometers, 5 to 15 kilometers, 40 to 10 kilometers, and 76 to 5 kilometers.

The velocity and direction of each flight was determined for levels of 0.25 kilometer to 1 kilometer and for each 0.5 kilometer above this. Velocities were then resolved into north-south and east-west components. The algebraic sum of these components for four months (November–February) in the wet season and four months (May–August) in the dry season are shown in Fig. 1. The normal meteorological conditions for these months are given in Table 1.

TABLE 1.—Normal meteorological conditions, Apia, Western Samoa

	Mean hourly value of—			Total rainfall
	Temperature	Pressure	Relative humidity	
	° C.	Milli-meters	Per cent	Milli-meters
November–February	26.12	756.47	84.2	352
May–August	25.44	768.87	82.2	104

At the surface there is a slight movement of the air toward the equator, which, as already stated, would be greater except for the shielding effect of hills. From 2.5 kilometers to 8.5 kilometers the air movement has a small poleward component. From this height to 12 kilometers, above which the number of observations is not sufficiently great to be relied on, there is a contrary movement toward the equator; indications are, however, that this equatorward movement does not persist to higher levels.

The low values of the north-south components are not due to large south values being canceled by large north values; the components themselves were consistently low. This was apparent while making the observations, the balloons being taken far out to the westward and then after passing through a very thin layer of nonmoving air were brought back approximately over the heads of the observers.

The east-west components are much simpler; the trade wind movement to the west decreases steadily with altitude, becoming zero at 2.5 kilometers in November–February, and 6.2 kilometers in May–August. The antitrades setting in at these levels continues to increase in velocity to a height of 12 kilometers.

The resultant wind was obtained by combining the components. The data for each period of two months are shown graphically in Figure 2. Owing to the prevailing cloudy weather during January and February, there are few balloon flights, and the intrusion of a westerly wind between the levels 2.0 kilometers and 5.5 kilometers is doubtful. Although the number of observations above the 15 kilometer level is small there seems to be no indication of an upper trade wind at an altitude less than 18 kilometers.

Observations are in progress with two theodolites and special light filters, the latter being of practical value in following balloons against the deep blue skies which occur here.

Acknowledgment is made to Dr. Russell Pemberton for his aid in the computational work and to the Chief of the United States Weather Bureau for the loan of apparatus.

HOURLY RAINFALL PROBABILITIES AT LANSING, MICH.

By C. L. RAY

[U. S. Weather Bureau, Lansing, Mich.]

Following the plan of Feldwisch, whose study of hourly precipitation for Springfield, Ill., appeared recently,¹² the writer has used a somewhat similar method in making an analysis of the Lansing, Mich., records, covering a period of 15 years, 1910–1924, inclusive. The months of May through October have been considered, the records being only occasionally lacking, due to failure of the recording gauge or to freezing temperatures in the extreme months. The tabulations will of course be useful principally to the local station, as requests come to hand for aid in planning rain insurance policies.

A table of frequency percentages for the several days of the months, as April 6, May 12, etc., does not appear to be of very much value, though sometimes information of this nature is requested by those interested in rainfall insurance for a particular day. Hourly frequencies however, reflecting diurnal influences are certainly worthy of some consideration by underwriters and any other proposing to enter into insurance agreements.

In Table 1 is shown the percentage frequency of 0.10 inch or more precipitation within 1, 2, 3, 4, 5, and 6 hours, beginning at midnight, 1 a. m., 2 a. m., etc., for the 24 hours. In Table 2 and Figure 1 the total hourly rainfall for the past 15 years is given, while in Figure 3 is shown the total hourly amounts for the combined six months period.

In June, according to Table 1, the maximum frequency of precipitation of 0.10 inch occurs during the six hours beginning at 4 p. m., while the hours beginning at 11 a. m., 12 noon, etc., until 4 p. m., 5 p. m., and 6 p. m., are all

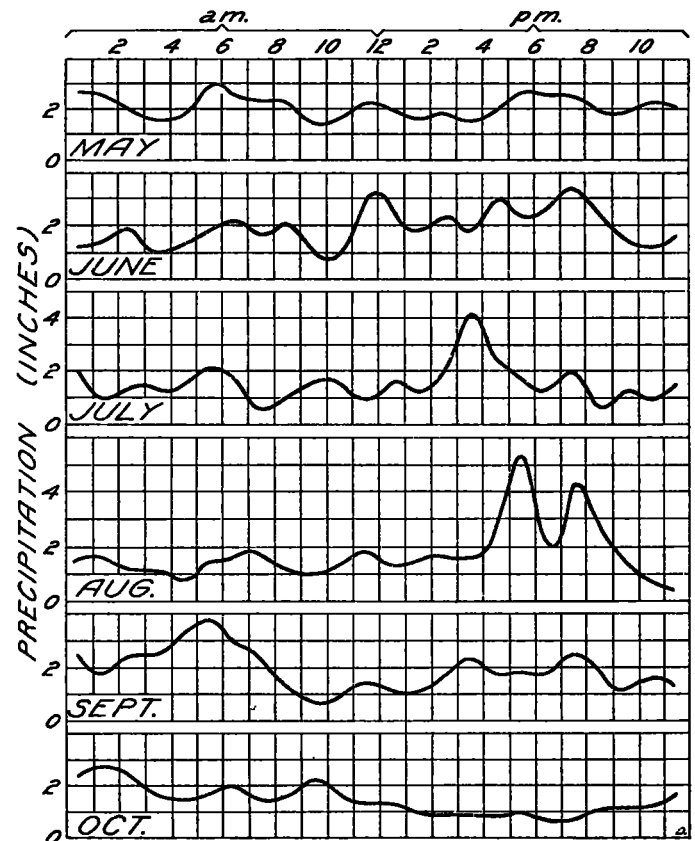


FIG. 1.—Total hourly amounts of precipitation, May to October, 1910–1924, inclusive, Lansing, Mich. Data from Table 2